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AGAR-WEED, A FISHERY RESOURCE

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Since ancient times certain seaweeds have been used as food, particularly by Oriental peoples. A few of these seaweeds are considered great delicacies. One favorite dessert of the Orient is a sweetened and flavored seaweed jelly. Until the middle of the seventeenth century, this jelly was always prepared from the dried seaweed just before it was to be eaten. It is to the unprecedented extravagance of a poor Japanese innkeeper in throwing out some of this seaweed jelly that America is indebted for what is possibly the smallest of its wartime-vital industries--the agar industry.



According to legend, a blizzard in about 1658 forced the Emperor of Japan to stop at a poor wayside inn in the mountains of Japan. The innkeeper had few fine foods to offer his august guest, but he could, and did, prepare large quantities of seaweed jelly. In fact, he prepared too much. Perhaps the left-overs were taboo for ordinary mortals, but whatever may have been the reason, Landlord Minoya threw the excess outdoors, where a portion caught on some bushes and froze during the night. Fair weather soon returned, and the chunks of jelly thawed and dried, leaving a spongy mass of negligible weight. Traditional Japanese thrift re-asserted itself, or perhaps it was scientific curiosity! Minoya took some of this sponge and boiled it. After cooling, the mass jelled, and the product was superior in flavor to the original seaweed jelly. This chance discovery became the basis of the large Japanese agar industry.

The seaweed was gathered and dried along the warm, sunny Japanese coast and stored until the wintertime. During the winter it was taken to the mountains, where the jelling material was cooked out of it and then purified by natural freezing and thawing in the cold air.

The eating of seaweed jelly was not confined to Japan, but was also common on the mainland of Asia and throughout the islands of the southwestern Pacific. It was from Java that this jelling material was introduced into America, and then into science. A Dutch family who had lived in Java first acquainted a New Jersey girl with it. She later became the wife of the German bacteriologist Hesse, and it was she who suggested to him that it might be superior to gelatin as a solidifying agent for bacteriological media. This proved to be the case, and "agar-agar" (or "agar") became indispensable to the bacteriologist and, therefore, vitally important to public health. A world market for the product was born.

Since the accidental discovery of the method of purification, the great bulk of the world's agar has been produced in Japan. Early in 1919, a group of Japanese-

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Americans organized a company to manufacture agar in California. Various species of red algae belonging to the genus Gelidium are much used for the manufacture of agar in Japan. Some of these Japanese-Americans observed seaweeds in California waters which looked much like Japanese Gelidium. Investigation proved that they were Gelidium and would yield agar. Only one species, Gelidium cartilagineum, proved capable of supporting an American industry. This is the American "agar-weed."

Agar-weed is a red-to-purplish seaweed which usually grows to a length of 15 to 24 inches off the Pacific Coast of southern California and Lower California. It has been reported to reach a length of 6 to 7 feet, but there are no authenticated records of such plants. The plant body consists of a round stem which is freely branched in the top half or third of its length. Agar-weed usually grows in fairly pure stands, but ordinarily these beds are small.

The weed grows from about mean lower low tide to a depth of about 60 feet. The portions of the coast which are suitable for the growth of agar-weed are very limited, because it grows only on exposed rocky coasts where surf-action is violent. The most favored sites are the sides of submerged rocks near their tops. Presumably, agitation of the water is greater here than on the top of the rock. The best agar-weed, therefore, is frequently found in a fringe around the top of the rocks. These factors influence the choice of gear for harvesting the weed.

The date when agar-weed was first gathered in the eastern Pacific is not known. The earliest picking was done by Japanese, apparently in Mexican waters, and the weed was shipped to Japan. In the early days of the California agar industry, much of the weed used was gathered from the San Pedro breakwater by "raking" it from the rocks. Some was also gathered by "skin diving," that is, by diving without suit or helmet. A 1921 newspaper article indicates that the Japanese-Americans harvested much of their weed from 3 or 4 fathoms by means of hooks attached to long poles. These California Japanese failed to obtain sufficient financial assistance or encouragement from their homeland and sold out to Americans.

Americans first gathered agar-weed about 1922, incidental to abalone-diving operations. They pulled up to 40 tons of dried agar-weed monthly off Lower California until taxes and regulations by the Mexican Government finally made harvesting unprofitable. The weed was sold to the American Agar Company (of Tropic, California) until this company failed, after which the weed was sold to Japan. The abalone-diving gear proved much more efficient than skin-diving or the use of long-handled hooks, and, since attempts to design a mechanical harvester have been unsuccessful, it is still the best known method.

The typical seaweed-diving boat is a gasoline-powered inboard vessel about 25 feet long, equipped with a compressor for the diver's air supply. The engine and controls are aft, while the hatch, line tender's station, and diver's ladder are forward. The boat is maneuvered, bow to seaward, over the rocks on which the agar-weed is growing. The diver, in full diving dress, including suit, helmet, heavy shoes, and lead back and chest weights, goes over the side with a rope basket. The cold southern California water makes a heavy suit of woolen underwear welcome. As the diver moves about on the bottom, he tears the weed from the rocks by hand and stuffs it into the rope basket. When the basket is full, a signal to the line tender causes the filled basket to be exchanged for an empty one. Each filled basket represents about 60 pounds of weed. One boat in a good area will gather, daily about a ton of wet weed which will dry down to about 600 pounds.

The operator must constantly maneuver the boat to keep it as near as possible to the diver. Bubbles rising from the diver's helmet indicate his position on

the bottom. Since the boat is usually in the breaker zone or just seaward of it, the operator must be alert at all times to avoid damage to the boat or injury to the diver or to the diver's air hose. The diver, of course, has the most difficult task. He is constantly being thrown about by the surge and, at times, may be almost exposed in the troughs of the waves. In deeper water, where the effect of the surge is less marked, he may go about on his feet, but in shallow water he must move about on hands and knees and hold on to the rocks or weeds to keep from being thrown into the crevices. Cotton gloves protect his hands from injury on sharp rocks or shells, but the knees of his suit have no protection. The life of a suit may be as short as 20 working days, thus, three to five suits are required by each diver during the working year of 100 to 120 days. It is obvious that the diver can work only when the sea is relatively calm.



Recognition of the valuable weed is difficult for the inexperienced diver in the flickering, uneven light below the surface. It is said that a diver once pulled a half-ton of worthless Plocamium before he discovered his error. In time the diver learns not to attempt to recognize agar-weed by its general form, but to look for the encrusting bryozoan, Membranipora tehuelcha (erroneously called "coral"), which grows in quantity only on Gelidium.

The "coral" is both desirable and undesirable. It enables the diver to recognize the plant, and its shell forms a rough crust on the smooth, slippery stem of the weed, thus insuring him a good grip when he pulls it off the rock. Since the coral contains no agar, it is merely a contaminant, and it may seriously reduce the value of the weed. Air-dry weed is usually bought on the basis of not more than five percent of foreign matter (including coral) and not over 20 percent moisture. Larger amounts of either moisture or foreign matter lower the market value of the weed. Samples of dried agar-weed have been reported to contain as much as 60 percent of coral.

The diver and boat operator frequently exchange places at noon, since a diver seldom cares for more than three or four hours under water per day. When the hold is full, or the day nearly over, the boat returns to port. If the weed is to be sold fresh, the boat crew's work is completed when the weed is unloaded and weighed. If it is to be sold dry, it must be trucked to the drying yards and spread out on the grass or on low wooden racks. It may be necessary to turn the weed occasionally to prevent rotting, if drying conditions are poor. After the Gelidium has dried sufficiently to prevent the growth of mold, it is baled with an ordinary hay baler.

At the present time no American divers are harvesting agar-weed. During the early part of the war many abalone and construction divers were attracted to weed diving by the high prices offered for the weed, and several diving boats were moved from Morro Bay to Newport, California. An established agar company contracted with several of the divers for their fresh weed at a relatively low price, and either provided the diving boat or paid maintenance cost of the privately-owned boats. During the summer of 1943 speculators and owners of agar factories under construction bid spiritedly against each other for baled dry weed

and succeeded in forcing prices so high that it proved to be unprofitable to sell the extracted agar at the established ceiling price. Rising prices of baled dry weed forced prices of fresh weed up also.

Commercial diving for the green abalone was re-opened, and some of the men returned to abalone-diving, which was easier work, since it was usually done in deeper water. It also brought better returns because of inflated wartime prices for abalone steaks. Diving contracts were modified to permit the divers to divide their time between abalone and agar-weed, but none of these arrangements succeeded in stabilizing the industry. When American weed became too costly, the agar manufacturers were forced to turn entirely to weed imported from Mexico. Very little Gelidium was harvested from American waters during the summers of 1944 and 1945.

Weed diving in Mexico is done from compressor-equipped rowboats which are towed to and from the diving area by a power boat. The actual diving equipment is the same as that used in American waters. A few harvesters, without sufficient capital for expensive equipment, collect weed by "raking" or "hooking." The small native agar industry uses some of this Mexican weed, and the surplus is sold to American companies.

Whether or not American weed-diving can be revived is problematical. It is doubtful that American-made agar can continue to command its present price in the face of competition from Japanese agar, when that again becomes available. If the price of agar must be reduced, the cost of weed must be more than proportionately reduced.

American divers earned good wages per working day. Their annual incomes from diving, however, were not very large, if the hazards of their work, the short diving season, and the relatively short active life of a diver are considered. If the divers were able and willing to engage in other pursuits on the days when diving is impossible or unduly hazardous, it is possible that the harvesting of the American agar-weed could be revived.

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